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The Repeated Evaluation Technique (RET). A Method to Capture Dynamic Effects of Innovativeness and Attractiveness

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SUMMARY

Innovativeness is defined as 'originality by virtue of introducing new ideas'. Thus, innovative designs often break common visual habits and are evaluated as relatively unattractive at first sight (Leder & Carbon, 2005). In most empirical studies, attractiveness is measured only once. These measures do not capture the dynamic aspects of innovation. This paper presents a dynamic procedure, the *Repeated Evaluation Technique* (RET), that improves the validity of attractiveness evaluations. RET simulates time and exposure effects of everyday life. Using RET, we investigated the appreciation of different car designs varying in innovativeness and curvature. While the mere exposure theory (Zajonc, 1968) would predict a general increase of liking in increasing exposure, RET revealed dissociate effects depending on innovativeness. Only innovative designs showed an increase in attractiveness. Low innovative designs were rated as being relatively attractive in the beginning, but did not profit from elaboration due to RET. Copyright © 2005 John Wiley & Sons, Ltd.

The measurement of attractiveness and innovativeness is a key challenge in the field of applied cognition. The successful implementation of new products depends on innovative designs and their perceived attractiveness. Innovation has a direct influence on the productivity and profit of companies and countries (Mairesse & Mohnen, 2002). However, as discussed by Cooper (2001), innovations are risky, therefore well considered concepts are essential to minimize possible innovation failures. For a long-life product like a car with typical developmental cycles of several years, innovations can turn out to be existential.

CONCEPT OF INNOVATION

Recent car models are often designed with the constraints of low air drag coefficient and other functional considerations (e.g. cross wind stability, production optimization, reduction of weight, ecological aspects, etc.). These functional considerations increase the homogeneity of competing designs. The consequences of homogeneity are far reaching, because indistinguishability lowers the brand value as well as the market value (Mazanec, 2001). In order to compensate for this, car designs have to be individualized without

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lowering the functional qualities. One possibility is to emphasize the idiosyncrasy of car interior designs (Karlsson, Aronsson, & Svensson, 2003). High distinctiveness of car interiors can accentuate the company's brand. Moreover, the inherent schema incongruity can increase cognitive elaboration (Meyers-Levy & Tybout, 1989). However, high distinctiveness is often correlated with lower attractiveness judgments in many objects (e.g. Barsalou, 1985; Martindale & Moore, 1988; Martindale, Moore, & West, 1988; Rhodes & Tremewan, 1996; Woll & Graesser, 1982). A plausible explanation for this effect is that low distinctive exemplars are closer to an average or prototype, which is more familiar and best liked (e.g. Gordon & Holyoak, 1983; Kunst-Wilson & Zajonc, 1980; Loken & Ward, 1990). At first sight, this seems to present a dilemma, because products should have the property of being attractive, but, they should also be distinctive enough to preserve the company's brand (cf. Hekkert, Snelders, & van Wieringen, 2003). Nevertheless, some distinctive and highly innovative designs not only gained the acceptance of the consumers but they also had a successful and long-lasting history of liking. Some examples of this are the futuristic Citroën DS, the innovative low-cost Citroën 2CV, the technical advanced BMW 60s-'new series' cockpit, the legendary simple silhouette of the early VW Beetle and Porsche 356/911, or the sportive styling of the Mercedes SLs. In these cases, designers have preserved elements of their formerly high innovative designs for a long time. Some of these innovation concepts had a long-lasting production life, as demonstrated by the general form of the VW Beetle and Porsche 911 series, or the driver-centred BMW interior design which was recently abandoned only after a 40-year production phase. Such examples demonstrate that distinctiveness can maintain consistency among members of a product family, which generates brand products (Park, Milberg, & Lawson, 1991) and preserves high attractiveness over a long period of time.

MEASUREMENT PROBLEM OF ATTRACTIVENESS AND INNOVATION

In experimental designs concerning attractiveness or innovation, both constructs are typically measured on ratings scales, in two-alternative choice tasks (a selection of one option from two possibilities) or in similarity decision tasks. The present study focuses on one specific problem which is crucial to the investigation of concepts of innovation. In experiments, attractiveness is usually tested only *once*. Such a method is capable of measuring only relatively stable concepts. However, the influences of innovation and of complex designs on attractiveness presumably are dynamical. Therefore, a test-retest design seems more appropriate to understand these dynamic aspects (cf. Collins & Sayer, 2001). To simulate everyday dynamics, participants should deal more thoroughly with the material. Otherwise, participants would evaluate the material by applying superficial or artificial strategies.

REPEATED EVALUATION TECHNIQUE

In this study, we present a procedure of repeated evaluation. This repeated evaluation technique (RET) is similar to the mere exposure approach of Zajonc (1968). There is strong evidence that attractiveness can increase through mere repetition (Zajonc, 2001). In typical mere exposure studies stimuli are usually presented up to 10–50 times (Bornstein, 1989). Bornstein presented results of a meta-analysis with more than 200 experiments addressing the mere exposure effect and found that the mean ceiling in number of stimulus presentations was 20.95 ($SD = 32.28$). Opposed to the general prediction of the mere exposure approach, some researchers even found a decline in attractiveness after a relatively small number of exposures (e.g. Crandall, Montgomery, & Rees, 1973, Exp. 3, with foreign words; Stang & O'Connell, 1974, with drawings and nonsense words; Zajonc, Shaver, Tavris, & Van Kreveld, 1972, with abstract paintings). Such a U-shaped attractiveness function would be fatal for the attractiveness of products with long developmental and renewal cycles. In addition, many studies used subliminal or very brief stimulus presentation times (Kunst-Wilson & Zajonc, 1980). However, as we are interested in applied topics of the liking of products, we chose frequent and long presentations in the present study.

The paradigm of mere exposure refers to *exposure*, but no deeper *elaboration* nor *evaluation* with the stimuli is considered. The participants are typically instructed to pay 'close attention' to the stimuli with no specific instructions given. According to applied research topics, it is important that subjects are not only passively 'exposed' to stimuli, but process them actively. This is important because real consumers are also actively involved with the products. There are only few studies, where participants had to familiarize themselves with the stimuli in an active sense. Crandall et al. (1973), for instance, increased the familiarity by instructing their participants to make ratings on bi-polar adjective rating scales. In a study by Birch and Marlin (1982), participants had to eat baby food they were later asked to evaluate. Such methods seem to be more adequate for testing consumers' preferences than typical mere exposure experiments (Stang, 1977). Moreover, only a few mere exposure studies used classes of unfamiliar stimuli, such as unfamiliar pictures, unfamiliar modern art works or unusual and unfamiliar symbols (e.g. Leder, 2003b; Standing & Thompson, 1990; Zizak & Reber, 2004). This seems problematic as novel products and designs seem to be particular relevant for applied cognitive research.

To increase the validity of testing innovativeness and attractiveness effects, we adopted the mere exposure procedure and transformed it into a *RET*. Here, the material has to be evaluated several times concerning different attributes. Usually, experimenters avoid massive repetition, because participants often become bored with the material. As a consequence, the attractiveness of the material tends to decrease over time (Bornstein, Kale, & Cornell, 1990; Zajonc et al., 1972). We think that repeated evaluation reflects object processing in everyday life and is more ecologically valid than the artificial setting of limited exposure to the material. Moreover, in everyday life, we do not become bored with *all* materials handled by us! Rather, we often have to adapt to new visual outlooks of most recent designs.

IMPACT OF INNOVATION

Zajonc et al. (1972) speculated on factors for the differential repetition effects, and concluded that 'It was not possible to specify which particular properties of stimuli make them vulnerable to satiation effects'. We think, that *innovation* might be an important factor underlying this effect. Highly innovative designs should increase the attractiveness and liking over time with repeated evaluation, whereas low innovative designs should be experienced as less attractive due to their low demanding nature. To our knowledge, up to now, mere exposure effects have not explicitly been tested with different levels of innovativeness.

EXPERIMENT

This experiment used a RET to stimulate everyday experience of new products. We used car interior designs with different levels of curvature and innovativeness as experimental stimuli. In the beginning, the pre-experimental level of attractiveness and innovativeness was measured and taken as the base rate of attractiveness. A treatment block followed in which all stimuli were rated on 25 different scales. Afterwards, attractiveness and innovativeness were measured a second time to reveal changes due to the intermediate repeated evaluation. We assumed that innovative designs benefit from repeated evaluation and that low innovative designs might lose some of their initial attractiveness. In order to control the impact of repeated evaluation, a control group was tested with a similar design but with no treatment condition.

Method

Subjects
Thirty-two participants with an average age of 26.1 years took part in the experiment; half of them were assigned to the treatment group (mean age: 25.1 years; 10 female), 16 other participants were assigned to the control group (mean age: 27.1 years; 10 female). One of the participants of the treatment group was replaced by an alternative subject due to omitted evaluations of attractiveness in the second test phase caused by a software error. Participants were naïve to the experimental hypotheses. They were paid 6 Euros for participating in the experiment. All participants were tested individually.

Apparatus and stimuli
Nine drawings of car interior designs were used as stimuli (see Figure 1). The stimuli were presented on an EIZO 21-inch CRT monitor with a size of 800×600 pixels at a screen resolution of 1024×768 pixels.

The car interiors varied according to the dimensions of *curvature* (straight, original, curved) and *innovativeness* (low, medium, high), which were fully balanced. These dimensions and the material are based on the stimuli used in Leder and Carbon (2005).

Curvature. Over the past five decades, car designs dramatically changed the amount of curvature. Curved designs were very popular in the late ’50s and early ’60s with extraordinary swung forms, particularly presented by the baroque-like American Cadillacs and Chevrolets and the European Citroën DS. Accented straight designs were established since the mid ’70s with the first VW Golf, later the angular Alfa Romeo 33 or the box-like Volvo 740 and Mercedes G. For the past decade, curved organic car designs became popular again, such as the Ford Ka, the MCC Smart and recently the Nissan Micra, VW Beetle, and Audi TT. Nevertheless, in the last few years, an increasing amount of straight forms combined with organic appeals were presented at international motor shows, e.g. with the BMW Z4 and the Opel Speedster (Vauxhall VX 220). We varied the curvature on three levels by decreasing or increasing the amount of curved elements in the car interior. Based on a relatively common appearance of the ‘original’ version with an average amount of curvature, we replaced all round forms by straight lines in the *straight* version. For the *curved* version, the same was done for the round forms, i.e. round forms were accentuated.

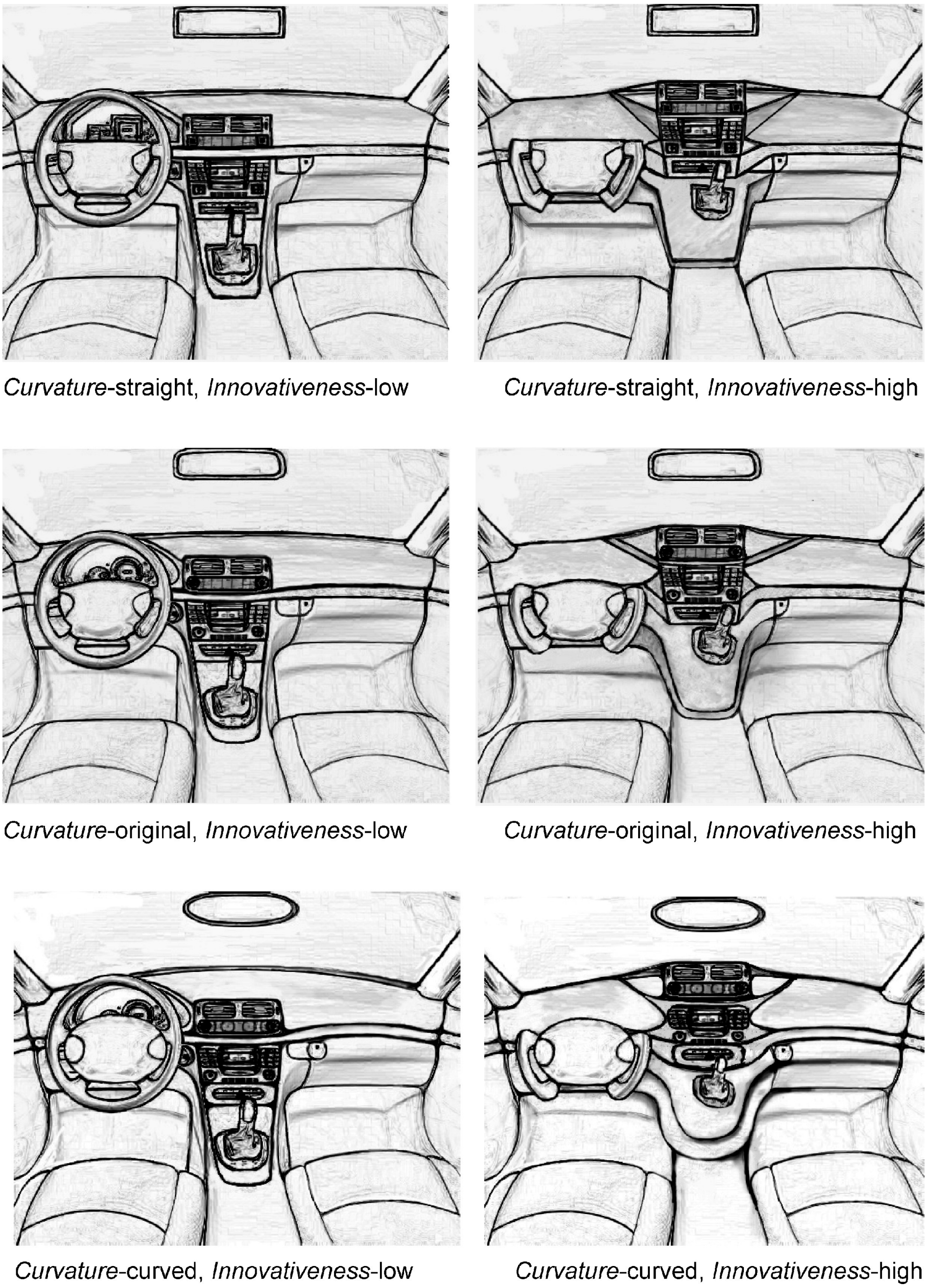

Figure 1. Examples of stimuli used in the experiment. Top row: straight designs with low and high innovativeness. Middle row: original designs (intermediate design between straight and curved). Bottom row: curved designs

Innovativeness. It is more difficult to operationalize the concept of innovativeness. Leder and Carbon (2005) showed that innovativeness can be significantly manipulated by varying the protuberance and size of the key modules in an interior. By changing the appearance of the steering wheel and the middle console in this way, the design was rated significantly more innovative. Here, three levels of innovativeness were used, shortly termed *low* innovative, *medium* innovative and *high* innovative.

Procedure

In an initial rating phase, the participants rated nine stimuli separately on scales of *attractiveness* and *innovativeness* (Test phase 1: T1). All ratings were made on a 7-point-Likert scale (1: least significant, 7: most significant); the stimuli were presented until the participants pressed a button for their evaluation. The participants had no time constraints for evaluating the stimuli. Both ratings were used as base rates. After this, an extended evaluation phase followed. For the treatment group (condition *RET*) this phase consisted of 25 rating blocks[1] containing the same car interiors as in T1. For the control group (condition *ZERO*), this phase consisted of questions concerning distances between German cities, which is a task that is not related to these car interiors but needs also high cognitive demands like the RET does. Both conditions lasted about 20–40 min.

The experiment continued with a short break of 1 min in which the participants were instructed to answer two final ratings as heedfully as possible. This was followed by the second and last rating phase for *attractiveness* and *innovativeness* (Test phase 2: T2).

The order of the rating blocks in the RET phase was randomized across the subjects, but was constant for T1 and T2 with attractiveness ratings in the first place and innovativeness ratings in the second place. The order of the stimuli presented in each block was fully randomized by the experimental software Psycope PPC 1.25 (Cohen, MacWhinney, Flatt, & Provost, 1993).

After the participants had finished the procedure on the computer, they had to answer three paper and pencil questionnaires. The first questionnaire asked for sociometric information, the second questionnaire contained questions on design knowledge and the third questionnaire was concerned with the participants' interest in art and aesthetics. In this final part, questions about artists and artworks were answered (for details about these tests see Leder & Carbon, 2005).

Results and discussion

Our main research question concerned the dynamic processing of attractiveness and innovativeness with innovative design. Therefore, we were mainly interested in whether repeated evaluation in the intermediate RET phase would result in changes of *attractiveness* (Table 1) and *innovativeness* (Table 2) between T1 and T2. All RET results were compared with results of the ZERO condition.

[1]The original German terms for the ratings were: 'abschreckend' (disgusting), 'angenehm' (pleasant), 'ansprechend' (appealing), 'bieder' (unsophisticated), 'durchdacht' (carefully designed), 'einladend' (inviting), 'elegant' (elegant), 'erdrückend' (overwhelming), 'extravagant' (extravagant), 'flippig' (hippy), 'futuristisch' (futuristic), 'gediegen' (solid), 'geschmackvoll' (tasteful), 'hochwertig' (of high quality), 'kitschig' (kitschy), 'komfortabel' (comfortable), 'konservativ' (conservative), 'luxuriös' (luxurious), 'modern' (modern), 'nüchtern' (plain), 'praktisch' (functional), 'stilvoll' (stylish), 'unübersichtlich' (over-ornate), 'verspielt' (ornamental) and 'überladen' (overloaded).

Table 1. Innovativeness ratings at T1 and T2, split by the experimental groups

	Low innov.		Medium innov.		High innov.	
	Innovativeness	*SD*	Innovativeness	*SD*	Innovativeness	*SD*
			Initial innovativeness rating (T1)			
RET	2.65	1.04	4.40	1.25	4.44	1.37
ZERO	2.63	1.63	4.31	1.50	4.60	1.55
			Final innovativeness rating (T2)			
RET	3.00	1.49	4.46	1.34	4.33	1.46
ZERO	2.65	1.63	4.59	1.37	4.65	1.62

Table 2. Attractiveness ratings at T1 and T2, split by the experimental groups

		Straight		Original		Curved	
		Attractiveness	*SD*	Attractiveness	*SD*	Attractiveness	*SD*
				Initial attractiveness rating (T1)			
Low innov.	RET	4.38	1.36	4.63	1.46	5.06	1.29
	ZERO	4.50	1.71	4.75	1.48	4.88	1.03
Medium innov.	RET	1.94	1.00	3.00	1.37	3.31	1.58
	ZERO	2.19	1.22	2.88	1.31	3.13	1.50
High innov.	RET	1.81	0.83	2.81	1.11	2.94	1.34
	ZERO	2.13	1.31	2.44	1.03	2.80	1.13
				Final attractiveness rating (T2)			
Low innov.	RET	3.69	1.40	4.44	1.15	5.06	1.39
	ZERO	4.31	1.62	5.00	1.55	4.63	1.50
Medium innov.	RET	2.38	1.41	4.00	0.63	4.63	1.36
	ZERO	2.31	1.08	2.88	1.20	3.31	1.45
High innov.	RET	2.44	1.15	3.81	1.28	4.13	1.63
	ZERO	2.00	0.97	2.69	1.08	3.13	1.26

Ratings of innovativeness

We tested whether the factor *innovativeness* was in accordance with the participants' evaluation of innovativeness. Most importantly, we were interested in the dynamic effect of innovativeness (i.e. the changes of perceived innovativeness over time). We analysed the innovativeness data with a three-way mixed-design analysis of variance (ANOVA) with *treatment* (RET, ZERO) as between-subjects factor and *phase* (T1, T2) and *innovativeness* (low, medium, high) as within factors. The only significant effect was the main effects of *innovativeness*, $F(2, 60) = 23.83$, $p < 0.0001$, $\eta_p^2 = 0.443$; no other effects were significant (ps > 0.21).

Scheffé post-hoc tests indicated that only the differences between *low* ($M = 2.73$, $SD = 1.29$) and *medium* ($M = 4.46$, $SD = 0.94$) innovative designs and between *low* and *high* ($M = 4.51$, $SD = 1.22$) innovative designs were significant (ps < 0.0001). The lack of an effect of *phase* (neither a main effect nor an interaction) indicates that the innovativeness appeared stable over the course of the experiment. Thus, the lack of a *treatment* effect shows that the RET procedure had no impact on the innovativeness ratings.

Ratings of attractiveness

In order to analyse the dynamic effect of the level of innovation on the perceived attractiveness, we first analysed the RET treatment data only. These findings were then cross-checked with the data of the control group (ZERO) in order to test the specificity of the RET treatment.

To analyse the RET data, we ran a three-way repeated measurement ANOVA with *phase* (T1, T2), *curvature* (straight, original, curved) and *innovativeness* (low, medium, high) as within factors and attractiveness as dependent variable. All main effects were significant: *phase*, $F(1, 15) = 9.81$, $p = 0.0068$, $\eta_p^2 = 0.395$, *curvature*, $F(2, 30) = 28.41$, $p < 0.0001$, $\eta_p^2 = 0.654$, and *innovativeness*, $F(2, 30) = 19.556$, $p < 0.0001$, $\eta_p^2 = 0.566$. Furthermore, the two-way interactions between *phase* and *innovativeness*, $F(2, 30) = 8.70$, $p = 0.0011$, $\eta_p^2 = 0.367$, and between *curvature* and *innovativeness*, $F(2, 30) = 3.00$, $p = 0.0254$, $\eta_p^2 = 0.166$, were significant. No other effects were significant (Fs < 2.49, ps > 0.1003).

Participants rated the car interiors in T2 ($M = 3.84$, $SD = 1.53$) as more attractive than in T1 ($M = 3.32$, $SD = 1.65$). At first sight this could be interpreted as a simple *mere exposure* effect (Zajonc, 1968). However, as indicated by an interaction of *phase* and *innovativeness*, this effect does not appear to be a *general* effect of *mere exposure*, but depends on stimulus' innovativeness. Figure 2 shows that an increase of attractiveness across the different measurements was not observed for the *low* innovative designs; rather, low innovative designs were evaluated as slightly less attractive in T2, $M_{\text{diff}} = -0.29$, $t(15) = 1.24$, $p = 0.1172$, *n.s.* Importantly, as low innovative designs were evaluated as medium high attractive (average attractiveness scores of 4.54 for the experimental group and 4.68 for the control group) and the appendant *SD*s were comparable with other conditions, the lack of an increase in attractiveness seems not to be based on a ceiling effect.

In contrast, *medium* and *high* innovative designs benefited from the repeated evaluation of the material in RET (medium innovative designs: $M_{\text{diff}} = 0.92$, $t(15) = 3.01$, $p = 0.0044$;

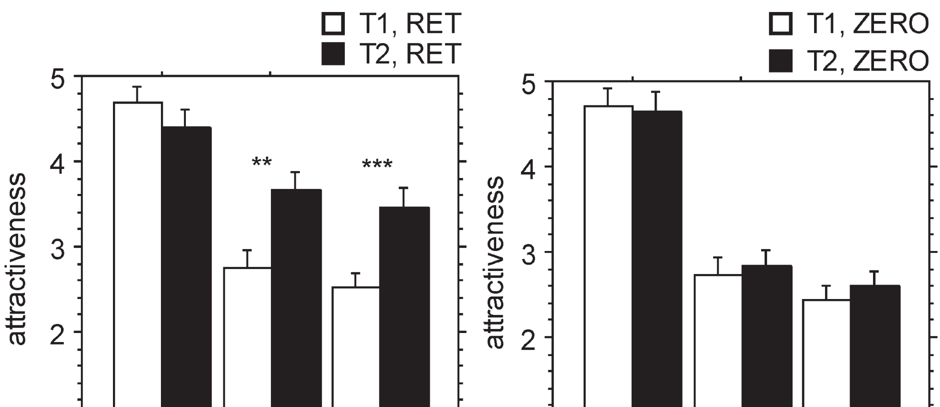

Figure 2. Interaction between *phase* and *innovativeness* on the attractiveness ratings, sampled over all variations of *curvature*. The error bars are *SE*s (of the mean). Asterisks indicate significant differences between the test phases using *t*-tests (**$p < 0.01$, ***$p < 0.001$)

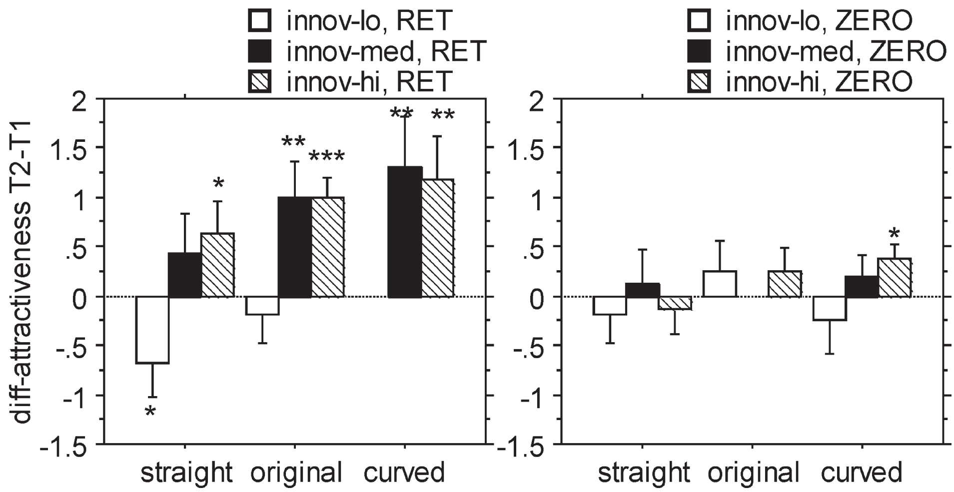

Figure 3. Differences of attractiveness of T2 minus T1 dependent from *curvature* and *innovativeness*. The error bars are *SE*s (of the mean). Asterisks indicate differences that are significantly different from 0, tested by one-group *t*-tests ($^*p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$)

high innovative designs: $M_{\text{diff}}=0.94$, $t(15)=4.26$, $p=0.0003$). In order to analyse specific interactions with the factor *curvature*, we also tested the differences of attractiveness of T2 and T1 (positive values indicate an increase in attractiveness from T1 to T2) for all combinations of *curvature* and *innovativeness* with nine independent *t*-tests (one-group *t*-tests against hypothesized 0). Figure 3 shows that only medium or high innovative designs benefited from the RET phase, $Ms_{\text{sdiff(T2-T1)}}>0.63$, $ts(15)>1.84$, $ps<0.0430$; the only exception was the medium innovative straight design, $M_{\text{diff}}(\text{T2-T1})=0.47$, $t(15)=1.10$, $p=0.1428$, *n.s.* In contrast to this, participants evaluated low innovative straight designs as less attractive after repeated evaluation, $M_{\text{diff}}(\text{T2-T1})=-0.69$, $t(15)=2.03$, $p=0.0301$.

This dissociate effect of *low* and *high* innovative designs is illustrated in Figure 4, which shows the extreme combinations of a 'low innovative and straight design' and of a 'high innovative and curved' design.

To test the dissociate effects of low and high innovativeness on attractiveness, an additional two-way repeated measurement ANOVA with *phase* (T1, T2), *design* ('innov-low and straight' vs. 'innov-high and curved') as within factors and attractiveness for the RET group as dependent variable was conducted. The only significant effect was the interaction between *phase* and *design*, $F(1,15)=18.26$, $p=0.0007$, $\eta_p^{\,2}=0.549$. No other effects were significant, $Fs(1,15)<3.06$, $ps>0.1005$.

In order to check whether the specificity of the RET procedure or the pure delayed testing of T2 was responsible for the found effects, we analysed the data of the RET group together with the ZERO group. Therefore, a four-way mixed-design ANOVA was conducted with the between-subjects-factor *treatment* (RET, ZERO) and the within-subjects factors *phase* (T1, T2), *curvature* (straight, original, curved) and *innovativeness* (low, medium, high). All within-subjects factor had significant main effects: *phase*, $F(1,30)=7.70$, $p=0.0094$, $\eta_p^{\,2}=0.631$, *curvature*, $F(2,60)=32.63$, $p<0.0001$, $\eta_p^{\,2}=0.521$, and *innovativeness*, $F(2,60)=42.44$, $p<0.0001$, $\eta_p^{\,2}=0.586$. Moreover, several two-way interactions were significant: *treatment* and *phase*, $F(1,30)=4.51$,

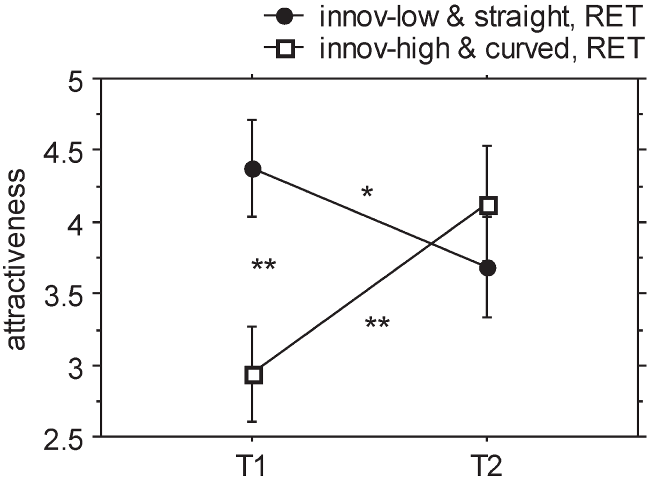

Figure 4. Interaction of attractiveness between *phase* and a subset of the stimuli, with only the 'innovative low and straight' design (innov-low & straight) and the 'innovative-high and curved' design (innov-high & curved) as the two most extreme designs used in the experiment. Only data from the RET group were used. The error bars are *SE*s (of the mean). Asterisks indicate significant differences between the conditions (*$p < 0.05$, **$p < 0.01$)

$p = 0.0422$, $\eta_p^2 = 0.131$, *treatment* and *curvature*, $F(2, 60) = 3.31$, $p = 0.0432$, $\eta_p^2 = 0.099$, *phase* and *innovativeness*, $F(2, 60) = 7.39$, $p = 0.0014$, $\eta_p^2 = 0.198$, and *curvature* and *innovativeness*, $F(4, 120) = 3.33$, $p = 0.0127$, $\eta_p^2 = 0.100$. Most importantly, the three-way interaction between *treatment*, *phase* and *innovativeness*, $F(2, 60) = 3.83$, $p = 0.0271$, $\eta_p^2 = 0.113$, was significant.

This three-way interaction between *treatment*, *phase* and *innovativeness* reveals that the attractiveness of different levels of innovativeness was modified by the treatment (with different effects for T1 than for T2). As shown by Figure 2, there was no influence of the ZERO condition on the attractiveness ratings (indicated by no differences between T1 and T2), while there was a strong influence of the RET condition, particularly for the medium and high innovative designs. We further investigated the influence of the ZERO condition by running nine independent *t*-tests for all combinations of *curvature* and *innovativeness* as already calculated for the RET condition (Figure 3). The only difference between T1 and T2 was found for the high innovative and curved design, $t(15) = 2.42$, $p = 0.0143$. This small effect might be an indication that even a brief familiarization given at T1 might induce the effect which was much more pronounced in the RET condition: innovative designs profited much more from repeated exposure than did low innovative designs. In sum, the three-way interaction reveals that innovation effects were strong and reliable in the RET condition but weak and unreliable for the ZERO condition.

Probably, high innovative designs were initially (i.e. at T1) disliked by the participants because they represented uncommon appearances, which break the common visual habits. This might be the reason why innovative designs are often evaluated as relatively unattractive at first sight (Leder & Carbon, 2005). However, after being exposed to these stimuli in the RET phase, participants presumably got used to the specific style of these stimuli and consequently showed a familiarity related increase in appreciation. Uncommon and distinctive style information is less cognitive fluent and might have a stimulating nature. Such a stimulating nature demands more attention and more cognitive effort. We assume that increased mental activity causes deeper elaboration of highly innovative material. Therefore, it is not only recognized faster and processed more accurately (cf. Bruce, Burton, & Dench, 1994; Light, Hollander, & Kayra Stuart, 1981) but might also be linked to personally relevant memory contents. These inferences indicate the dynamic character of innovativeness. In several studies concerning attractiveness, it was found that distinctive objects were judged less attractive than average objects (Rhodes & Tremewan, 1996; Vokey & Read, 1992; Wickham & Morris, 2003).

In order to understand the impact of *distinctiveness* and *typicality* on attractiveness, we ran a paper-pencil *Post Study* with 24 participants.[2] The results of the *Post Study* are shown in Table 3.

As shown in Table 3, high innovative designs were also evaluated as high in distinctiveness and low in typicality. Thus, concerning the car interiors used here, a close relationship between typicality and attractiveness was given only for the initial attractiveness rating at T1. The *Post Study* revealed that the innovative car designs were evaluated as highly distinctive (Table 3). Furthermore, as described by Leder and Carbon (2005), who used the same kind of stimulus material as has been used here, such innovative designs were also negatively related to complexity. Nevertheless, the attractiveness of these designs profited most from repeated evaluation.

This dissociate effect has a corresponding effect in everyday life. In the field of car design, it is a common-sense experience that new designs are often rejected and critically considered at first sight. High innovative designs often need time to be accepted. They do not match our attractiveness prototype and are therefore evaluated as relatively unattractive. However, elaborated exposure seems to integrate innovative designs into our cognitive system and change the basis of attractiveness. Thus, we assume that innovative designs, if they are well implemented, have the power to shift the prototype towards this new design outlook (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003).

In the present study, we demonstrated that such a shift might be established within a relatively short phase of repetitive evaluation to innovative material. Moreover, we showed

Table 3. Distinctiveness and typicality ratings including the *SD*s from the *Post Study*

	Straight		Original		Curved	
	Rating	*SD*	Rating	*SD*	Rating	*SD*
			Distinctiveness			
Low innovativeness	3.26	1.63	3.04	1.77	2.92	1.53
Medium innovativeness	5.85	1.06	5.21	1.41	4.63	1.31
High innovativeness	5.56	1.19	5.04	1.55	5.75	1.22
			Typicality			
Low innovativeness	5.39	1.56	6.26	1.01	5.71	1.04
Medium innovativeness	1.79	0.83	2.83	1.71	3.00	1.35
High innovativeness	1.94	0.78	2.42	1.32	2.25	1.45

[2]In the *Post Study*, 24 participants (average age was 26.3 years, 15 of them females), none belonging to the group of participants in the preceding experiment took part. The same nine drawings of car interior designs from the experiment were used and were rated for distinctiveness and typicality on separate 7-point Likert scales. Two separate ANOVAs with distinctiveness or typicality as dependent variables and *curvature* and *innovativeness* as independent within-subjects factors revealed consistent strong effects of *innovativeness* on both scales, $Fs(2, 42) > 32.00$, $ps < 0.0001$, $\eta_p s^2 > 0.604$: low typicality and high distinctiveness were closely related to high innovativeness (see Table 3).

that a single measurement of attractiveness does not account for the dynamic aspects of aesthetic appreciation and restricts the understanding and appreciation of innovation.

GENERAL DISCUSSION

The RET, as proposed here, increased the appreciation of innovative material. Importantly, the results of the ZERO condition exclude that it is simply an effect of two repeated measures. We interpret the trend that low innovative material is appreciated less after repeated evaluation as an effect of habituation. Bornstein (1989) argued that simple stimuli become boring faster than complex stimuli, resulting in a faster decrease of liking after being frequently exposed. Furthermore, the common finding that typical and low distinctive stimuli are particularly attractive (Martindale et al., 1988; Martindale & Moore, 1988; Woll & Graesser, 1982) was only found for the ratings of T1. For T2, this was no longer the case. Atypical and highly distinctive stimuli, as revealed by the *Post Study*, profited from repeated evaluation, whereas prototypical or low distinctive stimuli did not. Furthermore, as demonstrated by Leder and Carbon (2005), innovative designs are often low in complexity. Hekkert, Snelders, and van Wieringen (2003) found typicality and novelty as jointly effective in explaining the aesthetic preference of consumer products, but they claimed that both variables suppress each other's effect. Hekkert et al. (2003) demonstrated that products which show an optimal combination of both aspects were preferred. In our study, such an optimal combination probably was given. Although the innovative car interior designs have a novel appearance and therefore are not very typical, they still fit into a scheme of car interiors. Zajonc et al. (1972) puzzled about the particular properties of stimuli that make them vulnerable to satiation effects. We think that attributes of innovation might be an essential factor.

Interestingly, although *attractiveness* changed over time for different levels of innovativeness, the attribute *innovativeness* was stable. It is rather speculative to predict that innovativeness would change after a much longer time of exposure (e.g. thousands of exposure cycles, years of exposure, etc.). However, the effects found here reveal that innovativeness, as operationalized here, preserves its quality over time. As the RET increases familiarity of innovative material, the combination of innovation and familiarity in the long run might be the necessary condition for attractiveness. According to Bornstein's (1989) meta-analysis, heterogeneity of exposure sequences or delays between exposures and ratings should even strengthen this trend. On the one hand, innovation prevents boredom (see Bornstein et al., 1990), because of its demanding stimulus nature. On the other hand, increasing familiarity reduces uncertainty (Eckblad, 1972; Lee, 2001) and threat (Stang, 1974). This explanation is partly in accordance with the *two-factor model of exposure effects* described by Berlyne (1970) and Stang (1974). However, we propose to replace the collative factor *complexity* with a combined construct of *innovation* and other strong predictors like *meaningfulness* (see Martindale, Moore, & Borkum, 1990). Furthermore, our data show that there is no general relation between frequency of presentation and boredom. Innovative stimuli, unlike familiar stimuli, are better liked when presented with high frequency. This assumption would result in a change of the inverted U-shaped relation of liking and frequency of presentation, described by Berlyne (1970), into a monotonic increasing function (see Crandall et al., 1973; Zajonc, Swap, Harrison, & Roberts, 1971).

Another explanation for the strong effect of innovative designs on longer-term attractiveness is based on the *levels of processing* framework (Craik & Lockhart, 1972). Craik and Lockhart (1972) assumed that stimulus information is processed at multiple levels simultaneously depending upon its characteristics. Furthermore, they suggested that the 'deeper' the processing, the more will be remembered. Consequently, the novel, atypical and distinctive nature of innovative designs presumably will be elaborated on a deeper level. Therefore, they build deeper and more stable memory traces (e.g. semantic or meaning based processing) and are less susceptible to rapid forgetting. Due to the distinctive nature of innovative designs, people evaluate them as less attractive at the beginning, but perceive them with increasing familiarity and *cognitive fluency* (Leder, 2003a) when longer time spans are considered. This fluency might increase the overall attractiveness. However, only further studies employing repeated-exposure designs with controlled levels of active participation will be able to distinguish levels-of-processing explanations from mere exposure explanations for the effects found here.

Although averageness, prototypicality and familiarity are strong predictors for attractiveness and liking (Kunst-Wilson & Zajonc, 1980; Loken & Ward, 1990), there might be important exceptions due to the following effects. First, people sometimes might prefer novel products, because they are seeking variety (Berlyne, 1970; Hutchinson, 1986). Consumers sometimes also tend to select salient or unique products (Loken & Ward, 1990; Van Trijp, Hoyer, & Inman, 1996; Woll & Graesser, 1982). Furthermore, the very best products tend to be expensive. Therefore they are rare and atypical (Veryzer & Hutchinson, 1998).

The present experiment demonstrated the dynamic aspects of attractiveness and innovativeness. After repeated evaluations of car interior designs, the attractiveness ratings increased for higher innovative stimuli and decreased for low innovative material. Already established material, like well-known consumer products, might be validly evaluated by measuring attractiveness once. However, for novel and unfamiliar items and especially material with high innovativeness one measurement does not capture the dynamic aspects. The *RET*, as proposed here, seems to be a more adequate method for investigating the appreciation of innovation.

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